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JUL 29 2003
PATENT & TRADEMARK OFFICE

DOCKET NO: VISX0011U/US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: :
WILLIAM TELFAIR ET AL.

: GROUP: 5573

APPLICATION NUMBER: 09/307,988 : EXAMINER: DAVID M. SHAY

FILED: May 10, 1999 :

FOR: SHORT PULSE MID-INFRARED PARAMETRIC GENERATOR FOR SURGERY

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37 CFR 1.192 APPEAL BRIEF

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

Sir: In response to the final office action mailed March 24, 2003, the applicants appeal.

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I. 37 CFR 1.192(a)

This brief is filed in triplicate, is accompanied by the fee set forth in 37 CFR 1.17(c), and sets forth the authorities and arguments on which the appellant will rely to maintain the appeal.

II. 37 CFR 1.192(b)

The filing is timely. Accordingly, this subsection is not relevant.

III. 37 CFR 1.192(c)

A. 37 CFR 1.192(c)(1) - Real Party in Interest

The real party in interest is VISX, Incorporated of Santa Clara, California.

B. 37 CFR 1.192(c)(2) - Related Appeals and Interferences

There are no related appeals or interferences pending at this time.

C. 37 CFR 1.192(c)(3) - Status of Claims

Claims 61-84 and 90-96 are pending in the application, rejected and under appeal.

Claims 1-60 and 85-89 were cancelled.

The original claims 85-89 were cancelled by the way of presenting new claims numbered 85-89 in the amendment filed December 17, 2002. Claims 85-89 and 90-91 have been re-numbered by the Examiner as 90-96.

It is noted that the original claims 85-89, claims numbered 85-89 presented in the amendment of December 12, 2002 and re-numbered as claims 90-94 are identical.

Claims 61-84 and 90-96 were finally rejected in the office action mailed March 24, 2003.

Claims 61-84 and 90-96 are pending, rejected, and under appeal.

D. 37 CFR 1.192(c)(4) - Status of Amendments

An amendment after final rejection is filed concurrently herewith. In this amendment claim 80 is amended. Claim 80 is presented in the 37 CFR 1.192(c)(9) Appendix reflecting claim 80 before and after the instant amendment is entered.

E. 37 CFR 1.192(c)(5) - Summary of Invention

The invention of claim 61 provides a surgical method (page 7 lines 16-19), including steps of generating a pump beam pulse (10 lines 8-11); transmitting said pump beam pulse into a KTP crystal (page 13 lines 17-24) along a propagation direction that is substantially not parallel to a principle axis of said KTP crystal (page 14 lines 3-5); wherein said KTP crystal converts a

fraction of energy in said pump beam pulse into an idler beam pulse (page 10 lines 11-15), and said idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns (page 15 lines 4-8); and impinging said idler beam pulse on tissue (page 7 lines 15-19), thereby removing said tissue (page 10 line 24 to page 11 line 1).

The invention of claim 80 provides for a surgical method (page 7 lines 16-19), including steps of: generating a pump beam pulse (10 lines 8-11); transmitting said pump beam pulse through a mirror that is highly reflective to a wavelength of an idler beam pulse and highly transmissive to a wavelength of said pump beam pule, said mirror oriented at an angle of forty five degrees relative to said pump beam pulse (page 16 line 15 to page 17 line 2); transmitting said pump beam pulse into a crystal (page 14 lines 3-5); wherein said crystal converts a fraction of energy in said pump beam pulse into said idler beam pulse (page 10 lines 11-15), and said idler beam pulse wavelength is between about 2.90 to about 3.0 microns microns (page 20 line 19); and impinging said idler beam pulse on tissue (page 7 lines 15-19), thereby removing said tissue (page 10 line 24 to page 11 line 1).

The invention of claim 81 provides for a surgical method (page 7 lines 16-19), including steps of generating a pump beam pulse (10 lines 8-11); transmitting said pump beam pulse into a periodically poled KTP crystal (page 20 line 14); wherein said KTP crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse (page 10 lines 11-15), and said idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns (page 15 lines 4-8); and impinging said idler beam pulse on tissue (page 7 lines 15-19), thereby removing said tissue (page 10 line 24 to page 11 line 1).

The invention of claim 82 provides for a surgical method (page 7 lines 16-19), including steps of generating a pump beam pulse (10 lines 8-11); transmitting said pump beam pulse into a periodically poled LiNbO3 crystal (page 20 line 18); wherein said periodically poled LiNbO3 crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse (page 10 lines 11-15), and said idler beam pulse has a wavelength of between about 2.9 and about 3.0 microns (page 20 line 19); and impinging said idler beam pulse on tissue (page 7 lines 15-19), thereby removing said tissue (page 10 line 24 to page 11 line 1).

The invention further (claim 83) provides for a surgical method (page 7 lines 16-19),

including steps of generating a pump beam pulse (10 lines 8-11) at a wavelength of between about 0.85 and 0.90 microns (page 20 lines 24-25); transmitting said pump beam pulse into a non critically phase matched KTP crystal, X-cut (page 20 line 26); wherein said non critically phase matched KTP crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse (page 10 lines 11-15), and said idler beam pulse has a wavelength of between about 2.9 and about 3.0 microns (page 15 lines 4-8); and impinging said idler beam pulse on tissue, thereby removing said tissue (page 10 line 24 to page 11 line 1).

The invention of claim 90 provides for a surgical method (page 7 lines 16-19), including steps of generating a pump beam pulse (10 lines 8-11); transmitting said pump beam pulse into a crystal along a propagation direction;

wherein said crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse (page 10 lines 11-15), and said idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns (page 15 lines 4-8), a pulse width of not more than 50 nanoseconds (page 3 lines 11-13), and an energy of at least 5 millijoules (page 14 line 20); and impinging said idler beam pulse on tissue (page 7 lines 15-19), thereby removing said tissue (page 10 line 24 to page 11 line 1).

F. 37 CFR 1.192(c)(6) - Issues

1. Whether the rejection of claims 61-63, 65-80 and 85-96 under 35 USC 103(a) as being unpatentable over Lin US patent (5,520,679) in view of Tang et al. ("Tuning, Threshold, and Conversion Efficiency Properties of Critically Phase-Matched KTP OPOs", 266/CLEO'96/WEDNESDAY AFTERNOON), should be reversed.

2. Whether the rejection of claim 82 under 35 U.S.C. 103(a) as being unpatentable over Lin in view of Bosenberg et al. ("Mid-infrared Optical Parametric Oscillators Based in Quasi-Phasematching", Lasers and Electro-Optics Soc., Ann. Mtg. Proc 1995, Vol. 1, pp. 37-38) should be reversed.

3. Whether the rejection of claims 83 and 84 under 35 U.S.C. 103(a) as being unpatentable over Lin in view of Rines et al. ("Non-Linear Conversion of Ti: Sapphire Laser Wavelengths", IEEE Journal of Selected Topics in Quantum Electronics, Vol. 1, No.1, April 1995) should be reversed.

4. Whether the rejection of claim 81 under 35 U.S.C. 103(a) as being unpatentable over Lin in combination with Bosenberg et al. and further in view of Mead et al. (US patent 5,742,626) should be reversed.

G. 37 CFR 1.192(c)(7) - Grouping of Claims

Each one of claims 61-84 and 90-96 defines a separate group. The claims do not stand or fall together.

H. 37 CFR 1.192(c)(8) - Argument

1. 37 CFR 1.192(c)(8)(i) - First Paragraph 35 USC 112

The application is in compliance with the first paragraph of 35 USC 112. Accordingly, this subsection is inapplicable.

2. 37 CFR 1.192(c)(8)(ii) - Second Paragraph 35 USC 112

The application is in compliance with the second paragraph of 35 USC 112. Accordingly, this subsection is inapplicable.

3. 37 CFR 1.192(c)(8)(iii) - 35 USC 102

The application is in compliance with 35 USC 102. Accordingly, this subsection is inapplicable.

4. 37 CFR 1.192(c)(8)(iv) - 35 USC 103

a. Whether the Rejection of Each One of Claims 61-63, 65-80 and 85-96 under 35 USC 103(a) Based Upon U.S. Patent No. 5,520,679 to Lin ("Lin") in View of article "Tuning, Threshold, and Conversion Efficiency Properties of Critically Phase-Matched KTP OPOs" of Tang et al. ("Tang") should be reversed .

Claims 61-63, 65-80 and 85-96 stand rejected under 35 USC 103(a) as being unpatentable over Lin in view of Tang et al. It is presumed that the examiner issued this rejection for claims 61-63, 65-80 and 90-96 because claims 85-89 were cancelled and replaced by claims 90-96.

Several basic factual inquiries must be made to determine obviousness of claimed subject matter. In particular, "the scope and content of the prior art [are] to be determined...[and] the level of ordinary skill in the pertinent art resolved." <u>Graham v. John Deere Co.</u>, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation to modify the reference, or to combine references' teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference must teach or suggest all of the limitations defined by the claims. In re Vaeck, 20 USPQ 2d 1438 (Fed. Cir. 1991).

If the proposed modification of the prior art would change the principle of operation of the prior art, then the teaching of the reference is not sufficient to render the claims prima facie obvious. In re Ratti, 123 USPQ 349 (CCPA 1959). Moreover, a rejection must be based on substantial evidence. In re Gartside, 203 F.3d 1305, 1316, 53 USPQ2d, 1769, _____ (Fed. Cir. 2000).

The rejection of claims 61-63, 65-80 and 90-96 under 35 USC 103 (a) in view of the Lin patent and further in view of the Tang article is improper and should be reversed because no facts suggest an idler beam pulse having a wavelength of between about 2.75 and about 3.0 microns as defined by independent claims 61 and 90, or an idler beam pulse having a wavelength of between 2.9 and 3.0 microns as defined by independent claim 80.

In support of the rejections, the examiner states that:

> Claims 61-63, 65-80, and 85-96 [sic. 90-96] are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin in view of Tang et al. Lin teaches performing corneal sculpting with radiation in the 2.5-3.2 micron range generated by an OPO with pulse width in the 1-40 nsec range. Tang et al[.] teach producing radiation in the range of Lin using a CPM KTP OPO pumped at about 1 micron, the pump thresholds are discussed as 0.5 mj corresponding to 30 kw peak power and 17 MW/cm^2. To produce 0.5 mj with a 30 kw pulse requires a pulse width of 17 nanoseconds to [sic; . To] produce a power density of 17 MW/cm^2 with 30 Kw pulse yields (assuming a circular beam cross section) a beam radius of 563 microns which is well in excess of eight times the diffraction limit of the single mode beam. It would have been obvious to the artisan of ordinary skill to employ the OPO of Tang et al[.] in the method of Lin, since the enables effective tuning in the desired range as taught by Tang et al; to employ a mirror that transmits the pump pulse at a forty five degree angle thereto since the [sic; that] does not manipulatively affect the method and is notorious in the art; to tune the output to be in the 2.75-3.0 micron, since Lin gives no indication that this portion of Lin's range should be avoided, the claimed range is not critical; and wavelengths near 3 microns are notoriously useful for surgery, official notice of which is hereby taken; to increase the power of the pump beam by increasing the energy of the

pump, since this would reduce the thermal damage to the non-linear material compared to increasing the pulse width official notice of which is hereby taken [sic ;] and to transmit pump radiation exiting the crystal to a second KTP crystal and interlace the resulting idlers, since these are equivalents, provide no unexpected result, and are known configurations in the art, official notice of which is hereby taken thus producing a method such as claimed. [Office action page 2 line 11 to page 3 line 10; interpolation supplied.]

The applicants submit that this rejection is improper and should be reversed because it is not supported by substantial evidence.

1. **Lin patent**

The relevant teachings of the Lin patent are discussed below.

Column 9 lines 31-42 in Lin states that:

> The basic laser also includes a mid-IR (2.5-3.2 microns) laser generated from optical parametric oscillation (OPO) using a near-IR laser (such as Nd:YAG or Nd:YLF, flash-lamp or diode-pumped) as the pumping sources and KTP or BBO as the frequency conversion crystals. The OPO laser has advantages over the Q-switched Er:YAG laser, including higher repetition rate (10-5,000 Hz) and shorter pulse width (1-40 n.s.). These advantages provide faster surgical procedure and reduced thermal damage on the ablated corneal tissue. Typical energy per pulse of the OPO laser is (0.1-10) mj. Greater detail on OPO was published by the inventor in Optical Communications, vol. 75, p. 315 (1990).

Claim 18 in Lin states that:

> 18. A method of performing corneal refractive surgery by reshaping a portion of the corneal surface in accordance with claim 1 in which the step of controlling said scanning mechanism includes controlling said scanning to scan a pattern of radial aligned slits of fixed area using a laser beam capable of photoablating corneal tissue for laser radial keratectomy.

Lin is silent regarding phase matching.

Morever, Lin does not enable an OPO laser system for wavelengths in the 2.75 to 3.0 μm range. Lin cites at column 9 lines 41-42 to "Optical Communications", vol. 75, p. 315 (1990) for details on OPO. However, that paper "report[s] the first demonstration of a tunable mid-IR (1.8 - 2.4 μm) coherent source." See the abstract. Lin's reported <u>1.8 - 2.4 μm</u> wavelengths are outside of the <u>2.75 -3.0 μm</u> and <u>2.9-3.0 μm</u> wavelength ranges claimed herein. Lin contains no

disclosure enabling OPO in the 2.75 - 3.0 μm wavelength range.

2. **Tang et al.**

Tang et al. is a one page paper. Tang et al. discloses theoretical calculations (solid lines in figures 1a, 1b, and 2 and some experimental data (series of data points in figure 1a and two points in figure 2). Specifically, Tang et al.'s left hand column, second paragraph, starting "An initial theoretical comparison....") indicates that solid lines are theoretical predictions, not data. Moreover, Tang et al.'s caption for figure 2 indicates that symbols of a circle, a diamond, a plus sign, and a capital X represent data thereby implying that the solid lines represent the theoretical calculations.

Furthermore, the caption for figure 1 states "Experimental data is also shown" implying that the solid lines are theoretical predictions and the set of square and triangular symbols in figure 1a represent data. In addition, Tang et al.'s right hand column lines 14-15 states that "Measured signal/idler wave tuning is shown also in Fig. 1" apparently referring to the square and triangular symbols shown in figure 1a.

Tang et al. center column last full paragraph lines 1-10 states that:

> To compare and contrast the CPM device with the NCPM geometry, two 25-mm-long KTP crystals cut at ... , cut at $\theta = 90°$, $\phi = 0°$ and $\theta = 63.4°$, $\phi = 0°$ have been employed in our experiments. In the latter case, the calculated signal and idler wavelength pair at normal incidence are 1.714 μm and 2.69 μm respectively. The corresponding tuning rate about this point for the signal wave is 17.1 $\mathrm{nm.deg^{-1}}$.

The caption for figure 1 states that the pump wavelength was 1.047 μm.

Tang et al. figure 2 shows that the experimental data points are for data obtained near the intersection of the theoretical predictions for the threshold pump power and threshold intensity. As can be seen in figure 2, this intersection defines a relative minima of the product of the threshold pump power and threshold intensity, indicating to one of ordinary skill in the art criticality to that pair of values. Figure 1a shows data only for a two or three degree range of θ about 63.4 degrees, implying to one of ordinary skill in the art that no OPO lasing occurred outside of that range. That conclusion is consistent with the well known fact that non critical phase matching is very sensitive to the value of the angle θ.

Tang et al. does not state the experimental value of the conversion efficiency to the idler beam. Tang et al. discloses (right hand column lines 10-14) a thirty percent conversion efficiency to the signal beam. Presumably, the conversion efficiency to the idler beam was lower than the conversion efficiency to the signal beam since Tang et al. cites signal beam conversion efficiency, not idler beam conversion efficiency.

The examiner asserts that "to increase the power of the pump beam by increasing the energy of the pump, since this would reduce the thermal damage to the non-linear material compared to increasing the pulse width official notice of which is hereby taken," thereby <u>admitting</u> that "power of the pump beam", "energy of the pump," and "the pulse width" were known factors and <u>limitations relating to</u> "thermal damage to the non-linear material." This application also discloses the criticality of limiting the pump power in order to avoid destroying the optics. See page 3 line 18 to page 4 line 2 and page 8 lines 17-22. Tang et al. does not disclose any pump pulse power greater than 5 mj. This would have suggested to one of ordinary skill in the art (1) that pulses greater than 5 mj would have damaged Tang et al.'s optics and (2) that 5 mj pump pulses were the largest pump pulse energy Tang et al. believed to be usable without damaging their optics.

From the foregoing, one skilled in the laser arts would have concluded that Tang et al.'s maximum idler pulse generated by a KTP crystal having θ about 63.4 degrees, would have had had an energy of less than 1 mj at a wavelength of 2.69 μm. Moreover one skilled in the laser arts would have known (1) that the idler pulse energy would fall to <u>zero</u> as θ was increased to 65 or 66 degrees, by visual extrapolation the data in figure 1a, and (2) t hat the idler beam wavelength would concurrently increase from 2.69 μm to about 2.8 μm. See data in figure 1a. Based upon the foregoing, one skilled in the art would not have been led to believe that Tang et al.'s non critically phase matched laser system could produce anywhere near 1 mj of energy in idler beam pulses at or above a wavelength of 2.75 μm. For the same reasons, one skilled in the art would not have been led to believe that Tang et al.'s non critically phase matched laser system could function to produce an idler beam wavelength between about 2.90 and 3.0 μm.

This application discloses that "a desired laser source for this application would have an output energy up to 30 mj" for a surgical laser system operating around 2.94 μm. Page 3 lines

16-17. In addition, the Summary of the Invention section states that the "laser beam comprises ... pulses ... with an energy greater than 1 mj...", thereby suggesting to the reader that the inventors believed that a minimum useful idler beam pulse energy was "greater than 1 mj."

These statements are evidence supporting the conclusion that there would be no motivation to use a system limited to generating less than 1 mj per pulse. At best, Tang et al.'s laser might be capable of lasing at 2.75 μm, but with far less energy per pulse than 1 mj. For these additional reasons, the person of ordinary skill in the art would not have been motivated to try Tang et al.'s system to generate a wavelength above 2.75 μm. Therefore, the rejections relying upon the combination of the Lin and Tang et al. references are improper and should be reversed.

3. **Lin in view of Tang et al.**

There is no motivation to modify Lin in view of Tang et al. because Tang et al. does not disclose a system useful for surgery. In this regard, the examiner's assertion that there is no wavelength criticality is incorrect. This application and the prior art point out that there is an absorption maxima at a wavelength of 2.94 μm caused by the existence of the OH bond, and therefore there is an absorption maxima at 2.94 μm in tissue. In fact Dr. Telfair indicated that the absorption drops sharply outside of the claimed range. He indicated that the coefficient of absorption of tissue decreases by about an order of magnitude from its peak value at 2.94 as compared to its value above the upper claimed limit of 3.0 μm. Similarly, he indicated that the coefficient of absorption decreases by a factor of 2 from the peak value at 2.94 μm to a value at 2.90 μm, and decreases further as the wavelength decreases. Neither Lin nor Tang et al. provide an enabling disclosure of an OPO laser system that could generate laser radiation at 2.94 or in the 2.90 to 3.0 μm range. Given the extrapolated drop off in power with increasing wavelength suggested by Tang et al. and the knowledge in the art of reduced tissue absorption away from 2.94 μm, Tang et al. provided no motivation to use the non critically phase matched OPO laser as the OPO laser suggested by Lin. In this regard, it should be pointed out that this application, in contrast to Tang et al., does enable a laser surgical system for generating radiation in the 2.9 to 3.0 μm range. This application discloses at page 14 lines 18-20 a type II CPM x-cut KTP crystal with $\theta = 68\text{-}70°$, whereas Tang et al. disclose a crystal at $\theta = 63.4$ degrees. Thus, the

combination Lin with Tang et al. does not suggest the invention defined by claims 61, 80 and 90. Therefore, the rejections of those claims should be reversed.

b. **Whether the Rejection of Claim 82 under 35 USC 103(a) Based Upon U.S. Patent No. 5,520,679 to Lin ("Lin") in View of Article "Mid-infrared Optical Parametric Oscillators Based in Quasi-Phasematching" by Bosenberg et al. ("Bosenberg et al.") Should be Reversed .**

Claim 82 stands rejected under 35 USC 103(a) as being unpatentable over Lin in view of Bosenberg et al. In support of the rejections, the examiner states that:

> Lin teaches a method as claimed except for the particular non-linear material. Bosenberg et al[.] teach generating wavelength in the range desired by Lin using the non-linear material claimed. It would have been obvious to the artisan of ordinary skill to employ an OPO using the non-linear material of Bosenberg in the method of Lin since this can produce the desired wavelength[, the wavelength] is not critical[, and] provides no unexpected result, and does not manipulatively effect the method, thus producing method as claimed. [Office action page 3 lines 11-17].

Teachings of the cited references alone or in combination do not suggest the invention as claimed in claim 82.

As discussed above, Lin does not enable an OPO laser system for wavelengths in the 2.9 to 3.0 μm range. Lin cites at column 9 lines 41-42 to "Optical Communications, vol. 75, p. 315 (1990) for details on OPO. That paper "report[s] the first demonstration of a tunable mid-IR (1.8 - 2.4 μm) coherent source" (abstract). However, 1.8 - 2.4 μm is outside of the wavelength ranges claimed herein of 2.75-3.0 μm and 2.9-3.0 μm.

Bosenberg et al. does not provide motivation to use an idler beam having a wavelength which is "between about 2.9 and about 3.0 microns" as per claim 82. Bosenberg et al. generically discloses a possibility of achieving a tunning range anywhere between 1.35 and 4.9 μm. While that may be sufficient motivation to experiment, it is insufficient to provide a reasonable expectation of success in either achieving lasing or performing surgery with laser light in the 2.75-3.0 μm range. A reasonable expectation of success is necessary to support obviousness rejection of claims 83 and 84. In re Dow Chemical Corp., 837 F.2d 469, 473 (Fed. Cir. 1988).

Moreover, Bosenberg et al. does not disclose a system useful for surgery. Bosenberg et al. does not disclose or recognize the criticality of the specifically claimed wavelength range of 2.75-3.0 and 2.9-3.0 μm for surgical applications. Therefore, Bosenberg et al. does not suggest modifying the system disclosed in Lin.

For the foregoing reasons, the rejection of claim 82 is improper and should be reversed.

c. **Whether the Rejection of Each of Claims 83 and 84 under 35 USC 103(a) Based Upon U.S. Patent No. 5,520,679 to Lin ("Lin") in View of Article "Non-Linear Conversion of Ti: Sapphire Laser Wavelengths" by Rines et al. ("Rines et al.") Should be Reversed .**

Claims 83 and 84 stand rejected under 35 USC 103(a) as being unpatentable over Lin in view of Rines et al. In support of the rejections, the examiner states that:

> Lin teaches a method as claimed except for the pump wavelength. Rines teaches using a Titanium Sapphire laser to pump KTP to produce infrared radiation in NCPM OPO. It would have been obvious to use the of [sic.] OPO of Rines in the method of Lin, since it is not critical, provides no unexpected results, and does not manipulatively affects the method, thus producing the method such as claimed. [Office action page 3 line 19 to page 4 line 2.]

The appellants assert that teachings of the cited references alone or in combination do not suggest the inventions defined by claims 83 or 84.

Contrary to the examiner's assertion, Lin does not "teach a method as claimed except for the pump wavelength". Lin does not enable an OPO laser system for wavelengths of between about 2.9 and about 3.0 microns, or phase matching, as defined by claim 83.

Rines et al. generically discloses generating a pump beam pulse at a wavelength of between about 0.700 and 0.900 microns and converting a fraction of energy in the pump beam pulse into an idler beam pulse having a wavelength of anywhere between about 2.0 and above about 3.0 microns. See figure 9 on page 56 of Rines et al. Rines et al. does not disclose a system useful for surgery. Rines et al. does not disclose the criticality of wavelength for surgical applications. Therefore, there is no motivation to combine the teachings of Rines et al. with the teachings of Lin.

For the foregoing reasons, the rejections of claims 83 and 84 are improper and should be

reversed.

d. Whether the Rejections of Claim 81 under 35 USC 103(a) Based Upon U.S. Patent No. 5,520,679 to Lin ("Lin") in View of Article "Mid-infrared Optical Parametric Oscillators Based in Quasi-Phasematching" by Bosenberg et al. ("Bosenberg et al.") and Further in View of US Patent 5,742,626 to Mead et al. ("Mead et al.") Should be Reversed .

Claim 81 stands rejected under 35 USC 103(a) as being unpatentable over Lin in view of Bosenberg et al. and further in view of Mead et al. In support of the rejections, the examiner states that:

> Mead et al[.] teach equivalence of periodically poled LiNbO3 for non-linear wavelength conversion. It would have been obvious to the artisan of ordinary skill to employ periodically poled KTP in the method of Lin and Bosenberg et al[.], since this produces no manipulative effect and it is a recognized equivalent to periodically poled LiNbO3, as taught by Mead et al[.], thus producing a method such as claimed. [Office action page 4 lines 5-9.]

In response, the appellant assert that this rejection is improper and should be traversed for the same reasons discussed in the rejection of claim 82 over the teachings of Lin in combination with Bosenberg et al.

e. **Claim Groupings**

The claims do not all stand or fall together.

i. Group 1 - claims 61, 63, and 95.

The rejection of claims 61, 62 and 95 should be reversed because a surgical method, comprising generating a pump beam pulse, transmitting said pump beam pulse into a KTP crystal along a propagation direction that is substantially not parallel to a principle axis of the KTP crystal, in which the KTP crystal converts a fraction of energy in the pump beam pulse into an idler beam pulse, and the idler beam pulse has a wavelength of between about 2.75 and about 3.0, or between about 2.90 and 3.0 microns, and impinging said idler beam pulse on tissue, thereby removing said tissue as claimed in independent claim 61 and claim 95; or with a pulse of a duration less than 30 nanoseconds as claimed in claim 62 would not have been obvious from the teachings of Lin in view of Tang et al.

ii. Group 2 - claim 62.

The rejection of claim 62 should be reversed for the same reasons applicable to Group 1.

In addition, claim 62 recites generating said pump beam pulse having a wavelength of about one micron. Generating said pump beam pulse having a wavelength of about one micron would not have been obvious from the teachings of Lin and Tang et al.

iii. Group 3 - claim 64.

The rejection of claim 64 should be reversed because claim 64 is not recited in any of the outstanding rejections. Therefore, a prima facie showing that claim 64 is unpatentable is not established by the Examiner.

iv. Group 4 - claim 65.

The rejection of claim 65 should be reversed for the same reasons applicable to Group 1.

In addition, claim 65 recites generating said pump beam pulse as a multi mode beam having a divergence greater than eight times a diffraction limit of said multi mode beam. Generating said pump beam pulse as a multi mode beam having a divergence greater than eight times a diffraction limit of said multi mode beam would not have been obvious from the teachings of Lin and Tang et al.

v. Group 5 - claim 66.

The rejection of claim 66 should be reversed for the same reasons applicable to Group 1.

In addition, claim 66 recites pump beam pulse that has a diameter on the order of one to five millimeters. A pump beam pulse that has a diameter on the order of one to five millimeters would not have been obvious from the teachings of Lin and Tang et al.

vi. Group 6 - claim 67.

The rejection of claim 67 should be reversed for the same reasons applicable to Group 1.

In addition, claim 67 recites impinging said idler beam pulse on corneal tissue. Impinging said idler beam pulse on corneal tissue would not have been obvious from the teachings of Lin and Tang et al.

vii. Group 7 - claim 68.

The rejection of claim 68 should be reversed for the same reasons applicable to Group 1.

In addition, claim 68 recites sculpting a cornea with a plurality of idler beam pulses.

Sculpting a cornea with a plurality of idler beam pulses would not have been obvious from the teachings of Lin and Tang et al.

viii. Group 8 - claim 69.

The rejection of claim 69 should be reversed for the same reasons applicable to Group 1.

In addition, claim 67 recites cutting said KTP crystal for type II phase matching, and internal angles of sixty eight to seventy degrees. Cutting said KTP crystal for type II phase matching, and internal angles of sixty eight to seventy degrees would not have been obvious from the teachings of Lin and Tang et al.

ix. Group 9 - claim 70.

The rejection of claim 62 should be reversed for the same reasons applicable to Group 1.

In addition, claim 70 recites generating said pump beam pulse in one of a Nd: YAG, Nd:glass, Nd:YLF, and Nd:YAlO3 laser. Generating said pump beam pulse in one of a Nd: YAG, Nd:glass, Nd:YLF, and Nd:YAlO3 laser would not have been obvious from the teachings of Lin and Tang et al.

x. Group 10 - claim 71.

The rejection of claim 71 should be reversed for the same reasons applicable to Group 1.

In addition, claim 71 recites cutting said KTP crystal to have a length of at least 20 millimeters. Cutting said KTP crystal to have a length of at least 20 millimeters would not have been obvious from the teachings of Lin and Tang et al.

xi. Group 11 - claim 72.

The rejection of claim 72 should be reversed for the same reasons applicable to Group 1.

In addition, claim 72 recites that the KTP crystal has a principle axis, and the method further comprising rotating said KTP crystal relative to said principle axis. KTP crystal having a principle axis, and the method further comprising rotating said KTP crystal relative to said principle axis would not have been obvious from the teachings of Lin and Tang et al.

xii. Group 12 - claim 73.

The rejection of claim 73 should be reversed for the same reasons applicable to Group 1.

In addition, claim 73 recites that the step of transmitting comprises transmitting said idler beam pulse with an energy of between five and thirty milli joules. Transmitting said idler beam pulse with an energy of between five and thirty milli joules would not have been obvious from the teachings of Lin and Tang et al.

xiii. Group 13 - claim 74.

The rejection of claim 74 should be reversed for the same reasons applicable to Group 1.

In addition, claim 74 recites that said KTP crystal has a principle axis, and further comprising rotating said KTP crystal relative to said principle axis to an absorption wavelength of said tissue. That said KTP crystal has a principle axis, and further comprising rotating said KTP crystal relative to said principle axis to an absorption wavelength of said tissue would not have been obvious from the teachings of Lin and Tang et al.

xiv. Group 14 - claim 75.

The rejection of claim 75 should be reversed for the same reasons applicable to Group 1.

In addition, claim 75 recites that said KTP crystal converts at least one tenth of energy in said pump beam pulse into said idler beam pulse. That said KTP crystal converts at least one tenth of energy in said pump beam pulse into said idler beam pulse would not have been obvious from the teachings of Lin and Tang et al.

xv. Group 15 - claim 76.

The rejection of claim 76 should be reversed for the same reasons applicable to Group 1. In addition, claim 76 recites generating pump beam pulses at a rate of ten to fifty hertz. Generating pump beam pulses at a rate of ten to fifty hertz would not have been obvious from the teachings of Lin and Tang et al.

xvi. Group 16 - claim 77.

The rejection of claim 77 should be reversed for the same reasons applicable to Group 1.

In addition, claim 77 recites transmitting remainder of said pump beam pulse exiting said KTP crystal through a second KTP crystal. Transmitting remainder of said pump beam pulse exiting said KTP crystal through a second KTP crystal would not have been obvious from the teachings of Lin and Tang et al.

xvi.i Group 17 - claim 78.

The rejection of claim 78 should be reversed for the same reasons applicable to Group 1.

In addition, claim 78 recites transmitting said pump beam to said KTP crystal via one of a waveguide and a fiber optic bundle. Transmitting said pump beam to said KTP crystal via one of a waveguide and a fiber optic bundle would not have been obvious from the teachings of Lin and

Tang et al.

xviii. Group 18 - claim 79.

The rejection of claim 79 should be reversed for the same reasons applicable to Group 1.

In addition, claim 79 recites interlacing an idler beam pulse output generated in a second KTP crystal with said idler beam pulse. Interlacing an idler beam pulse output generated in a second KTP crystal with said idler beam pulse would not have been obvious from the teachings of Lin and Tang.

xix. Group 19 - claim 80.

The rejection of claim 80 should be reversed because a surgical method, comprising: generating a pump beam pulse, transmitting the pump beam pulse through a mirror that is highly reflective to a wavelength of an idler beam pulse and highly transmissive to a wavelength of the pump beam pule, the mirror oriented at an angle of forty five degrees relative to the pump beam pulse, transmitting the pump beam pulse into a crystal, wherein the crystal converts a fraction of energy in the pump beam pulse into the idler beam pulse, and the idler beam pulse wavelength is about 2.90 and about 3.0 microns; and impinging the idler beam pulse on tissue, thereby removing the tissue as claimed in claim 80 would not have been obvious from the teachings of Lin in view of Tang et al.

xx. Group 20 - claim 81 and 82.

The rejection of claims 81 and 82 should be reversed because a surgical method, comprising generating a pump beam pulse, transmitting said pump beam pulse into a periodically poled KTP crystal, wherein the KTP crystal converts a fraction of energy in the pump beam pulse into an idler beam pulse, and the idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns, and impinging the idler beam pulse on tissue, thereby removing said tissue as defined by claim 81 or, transmitting said pump beam pulse into a periodically poled LiNbO3 and the idler beam pulse has a wavelength of between about 2.9 and about 3.0 microns crystal as defined by claim 82 would not have been obvious from the teachings of Lin, Bosenberg et al., and Mead et al.

xxi. Group 21 - claim 83.

The rejection of claim 83 should be reversed because a surgical method, comprising

generating a pump beam pulse at a wavelength of between about 0.85 and 0.90 microns, transmitting said pump beam pulse into a non critically phase matched KTP crystal, X-cut, wherein the non critically phase matched KTP crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse, and the idler beam pulse has a wavelength of between about 2.9 and about 3.0 microns, and impinging the idler beam pulse on tissue, thereby removing the tissue as defined by claim 83 would not have been obvious from the teachings of Lin and Rines et al.

xxii. Group 22 - claim 84.

The rejection of claim 84 should be reversed for the same reasons applicable to Group 21.

In addition, claim 84 recites specific Ti:Sapphire and Cr:LiSAF lasers. Ti:Sapphire and Cr:LiSAF lasers would not have been obvious from the teachings of Lin and Rines et al.

xxiii. Group 23 - claims 90, 91 and 96.

The rejection of claims 90, 91 and 96 should be reversed because a surgical method, comprising generating a pump beam pulse, transmitting the pump beam pulse into a crystal along a propagation direction, where the crystal converts a fraction of energy in the pump beam pulse into an idler beam pulse, and the idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns or between 2.9 and 3.0 microns, a pulse width of not more than 50 nanoseconds, and an energy of at least 5 millijoules; and impinging the idler beam pulse on tissue, thereby removing the tissue as defined by claims 90, 91 or 96 would not have been obvious from the teachings of Lin in view of Tang et al.

xxiv. Group 24 - claim 92.

The rejection of claim 92 should be reversed for the same reasons applicable to Group 23.

In addition, claim 92 recites generating said pump beam at a wavelength of about one micron. Generating said pump beam at a wavelength of about one micron would not have been obvious from the teachings of Lin and Tang et al.

xxv. Group 25 - claim 93.

The rejection of claim 93 should be reversed for the same reasons applicable to Group 23.

In addition, claim 93 recites generating said pump beam with an energy of no more than 30 millijoules per pulse. Generating said pump beam with an energy of no more than 30

millijoules per pulse would not have been obvious from the teachings of Lin and Tang et al.

xxvi. Group 26 - claim 94.

The rejection of claim 94 should be reversed for the same reasons applicable to Group 23. In addition, claim 94 recites rotating said crystal relative to said propagation direction. Rotating said crystal relative to said propagation direction would not have been obvious from the teachings of Lin and Tang et al.

J. 37 CFR 1.192(c)(9) - Appendix

Appendix 1 contains a clean copy of pending claims.

IV. 37 CFR 1.192(d) - Non-compliant Brief

This brief is in compliance with 37 CFR 1.192(c). Accordingly, this subsection is inapplicable.

Respectfully Submitted,

7/26/03

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Printed: July 25, 2003 (2:19pm)

V. 37 CFR 1.192(c)(9) - Appendix

Appealed Pending Claims

Claims 61-84 and 90-96 are pending in the subject application. Claims 1-60 and 85-89 have been cancelled.

All pending claims are appealed.

61. A surgical method, comprising:

generating a pump beam pulse;

transmitting said pump beam pulse into a KTP crystal along a propagation direction that is substantially not parallel to a principle axis of said KTP crystal;

wherein said KTP crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse, and said idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

62. The method of claim 61 wherein said generating comprises generating said pump beam pulse having a wavelength of about one micron.

63. The method of claim 61 wherein said generating comprises generating said pump beam pulse such that said pulse has a duration of less than about 30 nanoseconds.

64. The method of claim 61 wherein said generating comprises generating said pump beam as a multi mode beam.

65. The method of claim 61 wherein said generating comprises generating said pump beam pulse as a multi mode beam having a divergence greater than eight times a diffraction limit of said multi mode beam.

66. The method of claim 61 wherein said pump beam pulse has a diameter on the order of one to five millimeters.

67. The method of claim 61 wherein said impinging comprises impinging said idler beam pulse on corneal tissue.

68. The method of claim 61 further comprising sculpting a cornea with a plurality of idler beam pulses.

69. The method of claim 61 further comprising cutting said KTP crystal for type II phase matching, and internal angles of sixty eight to seventy degrees.

70. The method of claim 61 wherein said generating comprises generating said pump beam pulse in one of a Nd: YAG, Nd:glass, Nd:YLF, and Nd:YAlO3 laser.

71. The method of claim 61 further comprising cutting said KTP crystal to have a length of at least 20 millimeters.

72. The method of claim 61 wherein said KTP crystal has a principle axis, and further comprising rotating said KTP crystal relative to said principle axis.

73. The method of claim 61 wherein said step of transmitting comprises transmitting said idler beam pulse with an energy of between five and thirty milli joules.

74. The method of claim 61 wherein said KTP crystal has a principle axis, and further comprising rotating said KTP crystal relative to said principle axis to an absorption wavelength of said tissue.

75. The method of claim 61 wherein said KTP crystal converts at least one tenth of energy in said pump beam pulse into said idler beam pulse.

76. The method of claim 61 further comprising generating pump beam pulses at a rate of ten to fifty hertz.

77. The method of claim 61 further comprising transmitting remainder of said pump beam pulse exiting said KTP crystal through a second KTP crystal.

78. The method of claim 61 further comprising transmitting said pump beam to said KTP crystal via one of a waveguide and a fiber optic bundle.

79. The method of claim 78 further comprising interlacing an idler beam pulse output generated in a second KTP crystal with said idler beam pulse.

80. (BEFORE AMENDMENT) A surgical method, comprising:

generating a pump beam pulse;

transmitting said pump beam pulse through a mirror that is highly reflective to a wavelength of an idler beam pulse and highly transmissive to a wavelength of said pump beam pules, said mirror oriented at an angle of forty five degrees relative to said pump beam pulse;

transmitting said pump beam pulse into a crystal;

wherein said crystal converts a fraction of energy in said pump beam pulse into said idler beam pulse, and said idler beam pulse wavelength is about 2.90 and about 3.0 microns; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

80. (AFTER AMENDMENT) A surgical method, comprising:

generating a pump beam pulse;

transmitting said pump beam pulse through a mirror that is highly reflective to a wavelength of an idler beam pulse and highly transmissive to a wavelength of said pump beam pules, said mirror oriented at an angle of forty five degrees relative to said pump beam pulse;

transmitting said pump beam pulse into a crystal;

wherein said crystal converts a fraction of energy in said pump beam pulse into said idler beam pulse, and said idler beam pulse wavelength is between about 2.90 and about 3.0 microns; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

81. A surgical method, comprising:

generating a pump beam pulse;

transmitting said pump beam pulse into a periodically poled KTP crystal;

wherein said KTP crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse, and said idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

82. A surgical method, comprising:

generating a pump beam pulse;

transmitting said pump beam pulse into a periodically poled LiNbO3 crystal;

wherein said periodically poled LiNbO3 crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse, and said idler beam pulse has a wavelength of between about 2.9 and about 3.0 microns; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

83. A surgical method, comprising:

generating a pump beam pulse at a wavelength of between about 0.85 and 0.90 microns;

transmitting said pump beam pulse into a non critically phase matched KTP crystal, X-cut;

wherein said non critically phase matched KTP crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse, and said idler beam pulse has a wavelength of between about 2.9 and about 3.0 microns; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

84. The method of claim 83 wherein said generating comprises generating said pump beam pulse in one of a Ti: Sapphire and a Cr: LiSAF laser.

90. A surgical method, comprising:

generating a pump beam pulse;

transmitting said pump beam pulse into a crystal along a propagation direction;

wherein said crystal converts a fraction of energy in said pump beam pulse into an idler beam pulse, and said idler beam pulse has a wavelength of between about 2.75 and about 3.0 microns, a pulse width of not more than 50 nanoseconds, and an energy of at least 5 millijoules; and

impinging said idler beam pulse on tissue, thereby removing said tissue.

91. The method of claim 90 wherein said step of generating said pump beam comprises generating said pump beam at a pulse duration of not more than 50 nanoseconds.

92. The method of claim 90 wherein said step of generating said pump beam comprises generating said pump beam at a wavelength of about one micron.

93. The method of claim 92 wherein said step of generating said pump beam comprises generating said pump beam with an energy of no more than 30 millijoules per pulse.

94. The method of claim 90 further comprising rotating said crystal relative to said propagation direction.

95. The method of claim 61 wherein said idler beam pulse has a wavelength of between about 2.90 and about 3.0 microns.

96. The method of claim 80 wherein said idler beam pulse has a wavelength of between about 2.90 and about 3.0 microns.

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